

Relevance of casual contact with peanut butter in children with peanut allergy

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Background: Casual skin contact or inhalation of peanut butter fumes is reported and feared to cause allergic reactions in highly sensitive children with peanut allergy but has not been systematically studied.

Objective: We sought to determine the clinical relevance of exposure to peanut butter by means of inhalation and skin contact in children with peanut allergy.

Methods: Children with significant peanut allergy (recent peanut-specific IgE antibody concentration >50 kIU/L or evidence of peanut-specific IgE antibody and one of the following: clinical anaphylaxis, a reported inhalation-contact reaction, or positive double-blind, placebo-controlled oral challenge result to peanut) underwent double-blind, placebo-controlled, randomized exposures to peanut butter by means of contact with intact skin (0.2 mL pressed flat for 1 minute) and inhalation (surface area of 6.3 square inches 12 inches from the face for 10 minutes). Placebo challenges were performed by using soy butter mixed with histamine (contact), and scent was masked with soy butter, tuna, and mint (inhalation).

Results: Thirty children underwent the challenges (median age, 7.7 years; median peanut IgE level, >100 kIU/L; 13 with prior history of contact and 11 with inhalation reactions). None experienced a systemic or respiratory reaction. Erythema (3 subjects), pruritus without erythema (5 subjects), and wheal-and-flare reactions (2 subjects) developed only at the site of skin contact with peanut butter. From this number of participants, it can be stated with 96% confidence that at least 90% of highly sensitive children with peanut allergy would not experience a systemic-respiratory reaction from casual exposure to peanut butter.

Conclusions: Casual exposure to peanut butter is unlikely to elicit significant allergic reactions. The results cannot be generalized to larger exposures or to contact with peanut in other forms (flour and roasted peanuts). (*J Allergy Clin Immunol* 2003;112:180-2.)

Key words: Peanut allergy, inhalation, skin contact

Peanut allergy affects 0.6% of the US population, and reactions to ingestion are often severe.^{1,2} Reactions to casual contact by means of inhalation or skin contact is reported usually in the context of school exposures in children, commercial airlines, or kissing,²⁻⁷ sometimes with

severe manifestations.^{6,7} However, these studies are based on self-report by affected subjects or adults supervising allergic children and are thus not verified (nor is ingestion typically excluded). A recent report verified allergic reactions to inhalation of vapors of several foods during cooking in a supervised challenge setting among asthmatic children with food allergy,⁸ but peanut was not investigated. The present study was designed to determine the clinical relevance of casual skin and inhalation contact with peanut in its most common form, peanut butter. In a double-blind, placebo-controlled study 30 highly sensitive children with peanut allergy were exposed to peanut butter in a manner that mimics the likely degree of exposure expected from casual contact in schools, in restaurants, or in the home.

METHODS

Subjects

Children with peanut allergy were recruited through the allergy practices of the Mount Sinai School of Medicine. Inclusion criteria were designed to enrich for children with a presumed increased likelihood for a systemic reaction from casual exposure. Thus subjects were eligible to participate if they met one of the following criteria. The first criteria is peanut-specific IgE antibody concentration of greater than 50 kIU/L (Pharmacia CAP System FEIA), a level associated with definitive reactivity (approximately 100%),⁹ poor long-term outcomes,¹⁰ and multiorgan system reactions.¹¹ The second criteria is any positive test response for peanut-specific IgE antibody and one or more of the following: a convincing reaction to peanut (reaction within 30 minutes to known peanut exposure involving typical symptoms affecting the skin, gut, or lung) involving more than one organ system (among skin, gut, respiratory, and cardiovascular systems) within 1 year; a positive physician-supervised oral food challenge result to peanut within 1 year; or a history of a reaction to airborne or skin contact with peanut. Additionally, subjects had to tolerate mint, soy, and tuna, which were used for masking. The study was approved by the Mount Sinai Institutional Review Board, and written informed consent was obtained.

Procedures

The aim of this study was to consecutively investigate 29 subjects if none experienced a systemic reaction (so that it could be stated with 95% confidence that 90% of patients with similar peanut allergy would not react¹²) or to continue recruitment to 50 subjects for descriptive statistical evaluation if any experienced a systemic reaction. For the day of challenge, subjects were to have had no antihistamines for 5 half-lives of the particular type, no recent use of β -agonists (5 days for long-acting β -agonists and 12 hours for short-acting β -agonists), no use of β -blockers, a stable clinical baseline (respiratory and skin disease), and FEV₁/forced vital capacity of greater than 80% of predicted value (for subjects able to perform spirometry). Challenges were randomized both for placebo and peanut and for inhalation or skin contact (morning or

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afternoon). Challenges were undertaken in the General Clinical Research Unit at Mount Sinai Hospital under physician supervision. Peanut IgE antibody concentrations of greater than 100 kIU/L were analyzed as 101 kIU/L.

Inhalation challenge. Three ounces of peanut butter (or soy butter placebo) was placed alongside tuna and mint extract (to mask odors) in a Styrofoam dish, pressed flat to maintain a standard surface area for challenges (6.3 square inches of peanut butter [16 cm²]), and covered with a single layer of gauze to mask visual identification. The preparation was made fresh for each challenge participant. The cup was held 12 inches from the subject's nose for 10 minutes in a standard ventilated room. The cups were covered with a plastic lid when not in use. Subjects were observed for an additional 60 minutes in a different room. Spirometry was performed before and after exposure in children able to cooperate.

Skin contact challenge. A syringe was used to dispense 0.2 mL of peanut butter (or soy butter mixed 9 parts to 1 with commercial histamine [histamine test control, histamine base 1 mg/mL; Center laboratories, Port Washington, NY] as a control for potential local reactions) onto a 2 × 2 piece of gauze. The gauze was applied with even pressure to intact skin on the lower back for 1 minute and then removed. The area of contact was wiped clean immediately after removal with 3 damp gauze pads in succession. The area was observed for local reactions, and the patient was observed for 60 minutes after each skin contact challenge.

RESULTS

The characteristics of the total study group and those who experienced reactions are shown in Table I. Nineteen (63%) subjects reported a previous reaction to skin contact or inhalation (5 children [17%] had a history of both a skin contact and inhalation reaction) to peanut. In regard to the 13 previous reactions from skin contact, 3 were from being kissed by an individual who ate peanut (not intimate kissing) and the remainder from touching items with peanut or peanut butter. The exact quantity of exposure was generally reported as small (eg, less than a pea-sized amount) or unknown, and ingestion could not be ruled out in most cases (aside from kiss reactions). Three of the reported reactions from skin contact resulted in systemic reactions (multiorgan system). Among the 11 previous reactions presumed caused by inhalation, causes included being in the same room or near peanut butter sandwiches (4 reactions), peanut candy (3), peanut craft projects (2), ground peanut (1), and breath from a person who ate peanut (1). Multiple organ system involvement was described for 5 of the reactions. The exact exposure level was difficult to assess for these onsite reactions, and ingestion could usually not be ruled out.

None of the 30 subjects had any respiratory or systemic (eg, anaphylactic) reactions during either inhalation or contact challenges with peanut butter. There were no reactions observed or subjectively reported for any subject during inhalation challenge with peanut butter. One patient reported transient palatal pruritus during inhalation challenge with placebo; however, this resolved spontaneously, and no other symptoms developed. For the 7 subjects completing spirometry, there was no significant change (none >6%) in FEV₁/forced vital capacity after inhalation challenge. The only noted reactions occurred at the site of skin contact with peanut, as indicated in Table

TABLE I. Characteristics of study subjects (n = 30) and reactions (n = 10)

Characteristic	
Age (y)	Median, 7.7 (range, 4.5-15.5)
Sex	17 (57%) male subjects
Peanut IgE (kIU/L)	Median, 101 (mean, 88.5; range, 2.2-101)
Atopic dermatitis	60%
Asthma	67%
Other food allergies	33%
Previous contact reactions	13 (43%)
Previous inhalation reactions	11 (37%)
Reactions on challenge test to peanut	
Inhalation	No reactions
Skin contact	Local erythema, 3 (10%); local pruritus without lesion, 5 (17%); local (single) wheal and flare, 2 (7%)

I. In addition, 5 (17%) of 30 subjects had localized erythema after contact challenge with placebo (soy butter with histamine). None of the subjects required medications to treat any of the mild reactions that occurred with the contact challenges, and no late-phase reactions were observed or reported. The results indicate with 96% confidence that at least 90% of individuals with similar peanut allergy would not experience generalized or respiratory reactions from similar exposures to peanut butter.

DISCUSSION

Although ingestion of peanut can clearly lead to severe reactions,³ the relevance of exposure through skin contact or inhalation is less well understood. Reactions to airborne peanut protein have been reported in relation to commercial airliners, when many packets of roasted peanuts are opened simultaneously.^{4,7} In such circumstances peanut dust might become airborne, and filters in these commercial airlines contain measurable amounts of peanut protein.¹³ The potential degree of exposure for inhalation exposure might be different for peanut butter, an oily substance from which protein might less easily escape. The published data concerning allergic reactions to inhalation exposure to peanut butter are based on self-report.²⁻⁷ Interestingly, only 1% of 4685 individuals in a national registry of peanut allergy reported reactions to airborne peanut²; it might be assumed that many are exposed without having reactions. When reactions have been reported, it is generally in circumstances in which skin contact or ingestion cannot be ruled out. Reports of allergic reactions to inhalation of other foods (fish, egg, milk, and pea) is almost always associated with active cooking of the food.^{8,14-16}

One might argue that allergic reactions to skin contact with a food to which the individual is allergic are expected. In fact, this is the basis of skin prick testing. Therefore the issue in regard to casual exposure is the potential to experience generalized reactions from skin contact. Indeed, diagnostic skin testing with peanut rarely leads to

reactions beyond the site of the skin test.¹⁷⁻¹⁹ Like inhalation reactions to peanut, reactions to skin contact have been reported within various studies that depend on self-reported reactions in which the extent of contact is uncertain or ingestion cannot be ruled out.^{2,6} The extent and location of contact would presumably be an important issue in this context. It would not be surprising, for example, for contact of peanut butter with the ocular mucosa during eye rubbing with peanut-contaminated fingers to cause significant eyelid edema, and this might even be interpreted by families as a severe reaction.

This is the first double-blind, placebo-controlled study to investigate the clinical responses to casual exposure to peanut butter occurring by means of inhalation and skin contact. Thirty children were tested, and none experienced a systemic or respiratory reaction. One third of the participants had a local reaction to the skin contact that did not progress. We elected not to treat these mild reactions but to observe them carefully for progression. This approach would not be recommended for exposures in the field. Overall, on the basis of the lack of systemic or respiratory reactions, it can be stated with 96% confidence that at least 90% of individuals with similar peanut allergy would not experience generalized or respiratory reactions from similar exposures to peanut butter.

There are several limitations to the current study. We selected a challenge format that we believed would mimic unintentional casual exposures to a common form of peanut, peanut butter, among subjects avoiding peanut. As such, we used a pea-sized amount of peanut butter for the skin contact exposure for 1 minute, as might occur from contact with poorly cleaned tables. We selected 10 minutes of exposure to the odor of peanut, as might occur when an allergic subject is near an individual who is consuming a peanut butter sandwich. Larger exposures were not investigated. Indeed, many of the self-reported reactions to casual exposure are described to occur with larger exposures (eg, a classroom in which most of the children are constructing projects with peanut butter). In addition, exposure to peanut in other forms (eg, flour and dust from roasted peanuts) was not investigated. As discussed above, dust from roasted peanut might be more likely to become airborne and induce reactions. Finally, the statistical power of our study was limited, but a much larger data set would be needed for minimal increases in power.

The issues of inhalation and skin contact reactions from peanut have strong practical implications for children with peanut allergy. Families of children with peanut allergy often fear that close proximity to peanut butter or casual skin contact could result in severe reactions. However, the fact that most individuals with peanut allergy have not experienced reactions in common settings² and that skin testing with peanut rarely leads to systemic reactions, combined with the results of this study, should allay many worries for these families. On the other hand, these results should not be misconstrued to mean that caution is not needed. Indeed, trace quantities of peanut can induce reactions when ingested,^{20,21} and intimate kissing,

although perhaps considered casual contact, is also akin to ingestion.⁵ Therefore the very same amount of peanut butter that when touched induces only a local reaction could cause anaphylaxis should it be unintentionally transferred to the mouth. With this in mind, continued caution is advised. Specifically, on the basis of this study alone, we would not recommend changing any school policies that protect children with peanut allergy.

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